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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference P18073WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEAA16)	
International application No. PCT/IB2003/002510	International filing date (day/month/year) 07.08.2003	Priority date (day/month/year) 07.08.2003
International Patent Classification (IPC) or both national classification and IPC H04Q7/34		
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1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

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International application No. PCT/B2003/002510

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Form PCT/PEA/409 (January 2004)

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB2003/002510

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-16
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-16
Industrial applicability (IA)	Yes: Claims	1-16
	No: Claims	

2. Citations and explanations

see separate sheet

Cited Documents

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1: WO 01/95657 A2

D2: US 2002/0155825 A1

D3: WO 02/39673 A1

D4: Bilgic, Essigmann et Al. : "Quality of Service in General Packet Radio Service", 1999 IEEE

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

A. Novelty / Inventive Step:

1. **Document D3** discloses (see in particular page 1, line 5 to page 3, line 21; page 4, lines 14-17; page 5, lines 17-24; page 6, lines 8-12; page 7, line 15 to page 11, line 10; page 16, lines 9-22; page 17, line 5 to page 18, line 2; page 19, line 8 to page 20 line 10; page 21, line 18 to page 22, line 11; page 23, lines 7-19, page 36, lines 1-6) according to the **essential features of claim 1**, a method of measuring (see in particular page 8, line 7: "measurements" and line 18: "gain measures") and analysing (see in particular page 9, line 17: "analysis") packet-switched traffic (see in particular page 3, line 3: "packet service") in a Universal Mobile Telecommunications System network having a mobile station linked to a base station through a radio channel (see in particular page 9, lines 3-4: "UMTS"), the base station being linked to a radio access network (see in particular page 9, line 3: "radio access network"), and the radio access network being linked to a support node in a packet core network (see in particular page 9, lines 3-4: "UMTS" and page 9, lines 16-21: "GGSN") wherein cell level location information of the mobile station is obtained in a node in the radio access network (see in particular page 9, lines 3-4: "radio access network...UTMS"; the availability of cell level location information of a mobile in a network element of the radio access network being **implicitly** included in radio access network according to the UMTS standard, see also PCT Guidelines 12.04), the method comprising transmitting user plane packets towards the packet core network (see in particular page 10, line 10: "packet flows" and page 8, line 26:

"mobile internet services" and page 9, lines 16-21), measuring the user data traffic at the packet core network level (see in particular page 9, lines 16-21:

"monitoring...analysis", "place it near the GGSN") and determining end-to-end quality of service metrics (see in particular page 10, lines 8-12: "end-to-end QoS metrics") for the mobile station (see in particular page 8, line 23 to page 9, line 4: "subscriber", "mobile") by analyzing the user data traffic (see in particular page 10, line 10: "observation of packet flows") measured at the packet core network level (see in particular page 9, lines 16-21: "at...high aggregation points of the network...near the GGSN").

The subject-matter of **claim 1** differs from that disclosed in **D3** in the features of adding cell-level location information to user plane packet headers, measuring **also the cell-level location information and packet data protocol context information** at the packet core network level, determining the end-to-end QoS by analyzing **also the cell-level location and PDP context information** measured at the packet core network level.

The **problem** to be solved by the present invention can therefore be regarded as how to obtain a more accurate evaluation of the quality of service.

However, already starting from the disclosure of **D3** (see in particular page 2, line 22 to page 3, line 3; page 9, lines 7-10 and page 23, lines 7-10) the skilled person would know that, in order to more accurately evaluate the quality of service, additional subscriber information can be provided, measured and analysed.

Additionally, the provision of mobile subscriber's information, as location information based on a cell identification carried by means of user plane packet headers and of PDP context information, merely represents a minor technical detail which is, furthermore normally known in wireless communications, as shown e.g in **D2** (see [0001]-[0030] and figure 1, with particular reference to [0024]-[0025]: "in every packet transmitted", "location information could be added", "header", [0008]: "on the basis of a cell identification"; [0017]: "location information e.g. cell" and [0017]: "operating state...PDP context") which relates to a similar mobile data services as in **D3**.

Consequently, merely modifying the method disclosed for a UMTS network in **D3**, in

order to obtain a more accurate evaluation of the quality of service, by defining the provision, measurement and analysis **also of additional information**, e.g. additional information consisting of cell based location and PDP context information according to the **same general principle** already known from **D2**, would merely represent an obvious implementation choice for the skilled person.

Therefore, the subject-matter of **claim 1** does not involve an inventive step (Article 33(3) PCT).

2. Similar consideration as made in paragraph A-1 are also applicable to independent **claim 14**, as its subject-matter corresponds to that of **claim 1** claimed with reference to a Universal Mobile Telecommunication System.

Furthermore document **D3** also explicitly discloses the details of a network monitoring device (page 9, line 18: "monitors"), the access network portion including nodes for transmitting data packets from the mobile stations towards the packet core network portion (page 9, line 3: "IP based radio access networks") and the monitoring device being placed at a point in the telecommunication network where the monitoring device measures information aggregated from a plurality of nodes (page 9, lines 16-21; page 17, line 10: "monitoring points..at junctures of high aggregation").

Therefore, the subject-matter of **claim 14** also does not involve an inventive step (Article 33(3) PCT).

3. Similar considerations as made in paragraphs A1-A2 above are also valid for independent **claim 15**, as its subject-matter corresponds substantially to that of **claim 1**, claimed with reference to a monitoring device.
Additionally it shall be noted that a monitoring device (page 9, line 18: "monitors"), one measurement point at a level where information of a plurality of mobile stations (page 9, line 3: "radio access networks") is aggregated (page 9, line 16-21: "high aggregation point of the network") and computing means for analysing the aggregated information (page 5, lines 21-22: "perform more complex statistics") are explicitly disclosed in **D3**.

Therefore, the subject-matter of **claim 15** also does not involve an inventive step

(Article 33(3) PCT).

4. Dependent **claims 2-12 and 16** do not contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the Article 33(3) PCT in respect of **inventive step**, because they are either directly derivable from the cited documents or represent obvious design possibilities for a person skilled in the field mobile communications.

Reference is made to the already cited passages of documents **D3** (see in particular page 1, line 5 to page 3, line 21; page 4, lines 14-17; page 5, lines 17-24; page 6, lines 8-12; page 7, line 15 to page 11, line 10; page 16, lines 9-22; page 17, line 5 to page 18, line 2; page 19, line 8 to page 20 line 10; page 21, line 18 to page 22, line 11; page 23, lines 7-19, page 36, lines 1-6) and **D2** (see [0001]-[0030] and figure 1) and also to document **D4** (Abstract: "wireless Internet" and page 230, lines 46-52 of paragraph C on the right-hand column : "encryption security payload tunneled packets").

Additionally the following should be noted:

- a) **Claim 10:** The **principle** of adding the location information by modifying the header of a tunneled packet is already explicitly disclosed in **D2** (see in particular [0025]). Adding the **same** cell location information according to the **same principle** by modifying the header of packets which are tunneled according to other well-known protocols, e.g. according to the well-known GTP tunneling protocol of the GPRS, would, therefore, merely represent a straightforward implementation alternative for the skilled person.
- b) **Claim 11:** Encrypting the information sent over a wireless network is commonly known in the art, see for example **D4**. Consequently, merely defining the encryption of a particular information or of a particular field would simply represent a straightforward implementation detail for the skilled person, not adding anything of inventive significance to the subject-matter of the claims.
- c) **Claims 12-13 and 16 :** Measurements for a plurality of subscribers and interfaces or for an entire network are already derivable from **D3** (see in particular page 9, lines 16-21: "large number of users in parallel", "a large network", page 17, line 10 and figure 3), whereas the inclusion of location and PDP context information is normally known in the art, e.g. from **D2** (see paragraph A-1 above).

Therefore, dependent **claims 2 to 13 and 16** do not meet the requirements of the Article 33(3) PCT.

B. Certain defects

1. The independent claims are not in the correct two-part form recommended by Rule 6.3 (b) PCT, having a pre-characterizing portion which reflects the prior art of document **D3** (Rule 6.3(b) (I) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

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difficult to associate the transactions measured at higher aggregation points with a mobility pattern tracked in an RRC trace. Furthermore the needed information in the RNCs is stored in a vendor-specific manner. Therefore, a measurement system that can be used in any type of UTRAN cannot be based on extracting information from the RNC. Yet another drawback is that, in order to ensure network security, safe operation of network nodes, and the like, operators typically do not allow for measuring teams (which may be external) to access important network nodes such as the RNC. Therefore, a solution with passive tapping at a standardized network interface is favored.

International Patent Application WO 01/95657 A2 appears to disclose a system and method for monitoring communications in a cellular telecommunication network and associated core network. When an access network sets up a communication with a mobile station, the access network sends a report message to the core network with an identity of the access network. However, there is no disclosure or suggestion of sending cell-level location information, or using this information to determine network performance.

United States Patent Application Publication 2002/0155825 A1 appears to disclose a method and system for providing a service to a mobile subscriber in a network. Specific information, which may include the location of the mobile subscriber, is provided to a service provider, which generates an individual service message on the basis of the provided information. However, there is no disclosure or suggestion of using cell-level location information to determine network performance.

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International Patent Application WO 02/39673 A1 appears to disclose a method and system for identifying and determining degradation of the quality of service (QoS) perceived by a subscriber in a network such as the Internet.

5 Traffic of individual applications of the subscriber and aggregate traffic of the subscriber are monitored, captured, and processed to produce QoS statistics. However, this document is applicable to the Internet, but there is no disclosure or suggestion of using cell-level location

10 information to determine network performance.

Thus there is a particular need for a cost-effective passive monitoring method that can be applied in the current mobility management architecture of UMTS networks.

15 **SUMMARY OF THE INVENTION**

The present invention is directed to a location-signaling system and method for large-scale end-to-end quality-of-service monitoring of packet switched telecommunications networks. The invention is especially useful for Universal

20 Mobile Telecommunications System (UMTS) networks in which the detailed mobility information is only available in an access network where the level of aggregation is not sufficient for reliable passive measurement-based characterization. An important advantage of the invention is that only a few

25 measurement points are needed. It is also advantageous that the existence of the cell-level location information in the UTRAN-to-core-network communication can be switched off in regular operation so that no extra load is generated in the network, and the operation of the network is left unchanged.

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WHAT IS CLAIMED IS:

1. A method of measuring and analyzing packet-switched traffic in a Universal Mobile Telecommunications System, UMTS, network having a mobile station (1) linked to a base station (2) through a radio channel, the base station being linked to a radio access network (3), and the radio access network being linked to a support node (7) in a packet core network (9), wherein cell-level location information of the mobile station is obtained in a node in the radio access network, said method being characterized by the steps of:

adding (22) the obtained cell-level location information to user-plane packet headers;

transmitting (23) the user-plane packets carrying the cell-level location information towards the packet core network;

measuring (24) the cell-level location information, user data traffic, and packet data protocol, PDP, context information at the packet core network level; and

determining end-to-end quality-of-service, QoS, metrics for the mobile station by analyzing (25) the cell-level location information, user data traffic, and PDP context information measured at the packet core network level.

2. The method of claim 1, wherein the step of measuring the cell-level location information includes measuring cell-level location information, user data traffic, and PDP context information in a plurality of radio access networks.

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3. The method of claim 2, wherein the step of measuring the cell-level location information and the PDP context information at the packet core network level includes measuring the cell-level location information and the PDP context information at an aggregation level at which user-plane traffic from the entire network is combined.

4. The method of claim 1, wherein the step of adding the obtained cell-level location information to user-plane packet headers includes adding the cell-level location information only when the radio access network detects that the mobile station is performing a handover.

5. The method of claim 4, wherein the handover is a hard handover, and the cell-level location information includes an identity of a new cell where the mobile station is located.

6. The method of claim 4, wherein the handover is a soft handover, and the cell-level location information includes an identification of the cells in a new active set of cells.

7. The method of claim 4, wherein the steps of adding the obtained cell-level location information to user-plane packet headers, and transmitting the user-plane packets carrying the cell-level location information towards the packet core network are performed only when cell-level location information is being measured.

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8. The method of claim 4, wherein the radio access network is a UMTS Terrestrial Radio Access Network, UTRAN, (3) and the support node is a Serving GPRS Support Node, SGSN, (7) and the step of measuring cell-level location information of the mobile station includes measuring the cell-level location information on an Iu interface link (6) between the UTRAN and the SGSN.

9. The method of claim 8, wherein the step of measuring the cell-level location information and the PDP context information at the packet core network level includes measuring the cell-level location information and the PDP context information for the entire network on a Gn interface (8) between the packet core network (9) and a Gateway GPRS Support Node, GGSN (10).

10. The method of claim 9, wherein the step of adding the obtained cell-level location information to user-plane packet headers includes adding the obtained cell-level location information to a General Packet Radio Service Tunneling Protocol, GTP, extension header.

11. The method of claim 10, wherein the step of adding the obtained cell-level location information to a GTP extension header includes encrypting the cell-level location information.

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12. The method of claim 1, wherein the UMTS network includes a plurality of mobile stations linked to a plurality of base stations through a plurality of radio channels, each of the base stations being linked to a UMTS Terrestrial Radio
5 Access Network, UTRAN, and a plurality of UTRANs being linked via a plurality of Iu interface links to a Serving General Packet Radio Service Support Node, SGSN, in a packet core network, wherein the measuring step includes measuring the cell-level location information for the plurality of mobile
10 stations and the PDP context information on the plurality of Iu interface links between the UTRANs and the SGSN.

13. The method of claim 12, wherein the packet core network is linked to a Gateway GPRS Support Node, GGSN,
15 through a Gn interface link, and the method includes the steps of:

passing the cell-level location information for the mobile stations and PDP context information from the plurality of UTRANs to the GGSN via the Iu interface links, the SGSN, the
20 packet core network, and the Gn interface link;

measuring on the Gn interface link, user-plane traffic for the entire network, said user-plane traffic including the cell-level location information for the mobile stations and the PDP context information combined from the plurality of
25 UTRANs; and

determining the end-to-end QoS metrics for the mobile station by analyzing the cell-level location information and PDP context information for the entire network.

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14. A Universal Mobile Telecommunication System, UMTS, network for exchanging data packets, said telecommunication network including an access network portion (3) for connecting a plurality of mobile stations (1) to the telecommunication network, a packet core network portion (9) for connecting the access network portion to external networks (12, 13), and at least one network monitoring device (16), wherein the access network portion includes nodes for transmitting data packets from the mobile stations towards the packet core network portion, said telecommunication network characterized by:

at least one of said nodes in the access network portion including means for adding cell-level location information to the data packets that are transmitted towards the packet core network portion; and

the monitoring device being placed at a point (15b) in the telecommunication network where the monitoring device measures cell-level location information aggregated from a plurality of nodes, and determines end-to-end quality-of-service, QoS, metrics for the mobile station by analyzing the cell-level location information and PDP context information for the plurality of nodes.

15. A monitoring device (16) for measuring and analyzing packet-switched traffic in a Universal Mobile Telecommunication System, UMTS, radio telecommunication network having a plurality of mobile stations (1) linked to a plurality of base stations (2) through a plurality of radio channels, each the base station being linked to a radio access network (3), and a plurality of radio access networks being

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linked to a support node (7) in a packet core network (9),
said monitoring device characterized by:

at least one measurement point (15b, 17) for measuring
cell-level location information of the mobile stations at a
5 level in the network where the cell-level location information
of a plurality of mobile stations is aggregated; and

computing means for determining end-to-end quality-of-
service, QoS, metrics for the mobile station by analyzing the
measured aggregated cell-level location information.

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16. The monitoring device of claim 15, further
comprising means for obtaining packet data protocol, PDP,
context information for the packet switched traffic, wherein
the computing means includes means for analyzing the PDP
15 context information together with the measured cell-level
location information for the entire network.